Power Supply and Load Reduction Technology Options For Audio Equipment Manufacturers To Meet the ENERGY STAR® Specification

Executive Summary

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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) has proposed a two-tier specification for the ENERGY STAR® Audio and Digital Versatile Disc (DVD) Program.[1] Between now and January 1, 2003, the proposed standby power limit is 2 watts. After January 1, 2003, the proposed standby power limit is 1 watt. This report presents eight designs for power delivery systems that meet the specification.

Options for Fully Featured Products with Standby Functions

- Starting with the next manufacturing cycle in early 1999, manufacturers can produce many fully featured audio product lines with standby functions that meet the EPA 2-watt standby power limit without loss of product performance and at estimated incremental costs ranging from minus (-) $2.00 to less than $0.50 per product unit.
- Given the pace of innovation and market trends, manufacturers will likely be able to produce—before the year 2003—all mass-market, fully featured audio product lines with standby functions that meet the EPA 1-watt specification without loss of product performance at no incremental cost per product unit.

In terms of design sophistication and cost, each product line includes a range of low-end to high-end audio devices. This report presents cost ranges because the manufacturer's cost depends on many design factors, including the audio device's operational load, whether the product has an internal or external power supply, the origin of parts, and volume pricing—to name a few.

Within the context of a product's overall power requirements, a variety of technologies can be used to meet the specification, depending on the energy needs of the product's standby functions. Fully featured products—those with functions such as remote control, user-setting memory, and clock displays—require up to 500 mW of useful power using current technology to supply these standby demands. Table ES-1 presents the three most promising technologies available today. The table emphasizes the estimated savings or low added cost for an efficient design relative to the cost of an existing linear power supply for products in the 5- to 10-watt range.

The most promising design is the high side switcher, which has been cost competitive since 1997.

[1] The EPA Audio/DVD Memorandum of Understanding (MOU) identifies 14 product lines: cassette decks, CD players/changers, clock radios, DVD products, equalizers, laserdisc players, mini- and midi-systems, minidisc players, powered speakers, rack systems, stereo amplifiers/pre-amplifiers, stereo receivers, table radios, and tuners.

Today's high side switchers can replace leaking power supplies at a cost savings, particularly for many devices with loads of 4 to 10 watts or more. This covers most mass-market audio products. The high side switcher can save manufacturers $0.95 to $2.03 per product unit.

Table ES-1: Estimated Added Cost of the Three Most Promising Designs for Fully Featured Products with Standby Functions

Design Option	Added Cost (Savings)
	per unit
High side switcher	($0.95) to ($2.03)
Low voltage switcher	$0.00 to $1.00
Improved transformer	$0.25 to $1.50

Note: Estimates are based on 5-watt and 10-watt power loads. Actual costs and savings will vary depending on the device, its operational load, volume pricing, and design choices. Estimates are good for the next manufacturing cycle.

Audio products with very high outputs, such as amplifiers, rack systems, and mini-/midi-systems that consume more than 10 watts when active, may have transformer losses which preclude them from the specification. For these devices, it may be more cost effective to disconnect the main power supply and serve the standby functions using a capacitive auxiliary supply, an AC/DC auxiliary supply, or a pulse charged battery. These products may require small investments to meet the specification. To the consumer purchasing one of these high-output devices, this means a zero net cost increase in products priced under $175.00 and up to a $5.00 net cost increase in products priced over $175.00. As a result of energy savings and simpler manufacturing designs, however, the improvements proposed in this report would generate net life-cycle cost savings.

Load Reduction in Fully Featured Products with Standby Functions

Manufacturers should not disregard load reduction opportunities. Slight changes in design choices can greatly reduce their products' energy needs while in standby mode. As illustrated in Table ES-2, three currently available cost-effective load reduction technologies are presented in this report: replacing vacuum fluorescent displays (VFDs) with liquid crystal displays (LCDs), using a photosensor for daylight harvesting, and cycling the remote control receiver. Reducing the standby load saves energy and allows manufacturers to select less expensive power supplies.

Table ES-2: Estimated Added Cost of the Three Most Promising Load Reduction Techniques for Fully Featured Products with Standby Functions

Load Reduction Design Option	Added Cost (Savings)
	per unit
VFD to LCD	($0.10) to ($2.00)
Daylight harvesting	$0.08 to $0.10
Cycling remote control receiver	$0.05 to $0.10

Note: Actual costs and savings will vary depending on the device, its operational load, volume pricing, and design choices. Estimates are good for the next manufacturing cycle.

Options for Products with No Standby Functions

Most of the audio products at the lowest end of the market have no standby functions. Therefore, these products have no energy needs when powered down. Even without the need for standby current, these devices consume energy because their linear power supplies leak electricity. To overcome this, the options are to improve the transformer or to disconnect it on the high-voltage side (primary side).

All three suggested design options for products with standby functions—the high side switcher, the low voltage switcher, and the improved transformer—improve the power supply system. They work equally well on products without standby functions because their no-load losses are minimal (in the milliwatt range).

For products with no standby functions, an On/Off 110V power switch on the product or on the wall adapter eliminates energy losses at approximately zero incremental cost.

In order of cost-effectiveness, Table ES-3 presents five design choices that improve the energy efficiency of devices with no standby functions in order to meet the EPA specification. Three of the five are improved power supplies (i.e., high side switcher, low voltage switcher, and improved transformer). The other two (i.e., 110V switch on audio device and power switch on wall adapter) meet the specification by disconnecting the power supply on the primary side.

Table ES-3: Estimated Added Cost of the Five Most Promising Designs for Products with No Standby Functions

Type of Design	Added Cost (Savings)
	per unit
High side switcher	($0.95) to ($2.03)
110V switch on audio device	$0.00 to $0.25
Power switch on wall adapter	$0.00 to $0.25
Low voltage switcher	$0.00 to $1.00
Improved transformer	$0.25 to $1.50

Note: Estimates are based on 5-watt and 10-watt power loads. Actual costs and savings will vary depending on the device, its operational load, volume pricing, and design choices. Estimates are good for the next manufacturing cycle.

The Next Step

Current technology allows proactive manufacturers to go beyond the EPA specification. Improved low-power delivery systems, such as the high side switcher and the low voltage switcher, make possible entirely new product lines of energy-efficient devices. These delivery systems, used in conjunction with load reduction techniques and conscientious engineering choices, create opportunities to manufacture "permanently on" products that have negligible power needs when powered down.

Other ENERGY STAR® products, such as computers and copiers, already have this power-down capability after performing their main functions. At this time, no engineering or cost barriers prevent manufacturers from designing audio devices that power themselves down after delivering services and then consume less than 1 or 2 watts.